3.9 b derivatives of logarithms

log is inverse of exp.

$y = \log_a x$ means $a^y = x$

properties

$\log(ab) = \log a + \log b$

$\log\left(\frac{a}{b}\right) = \log a - \log b$

$\log a^x = x \log a$

$\ln e = 1$

$\log x = \log_{10} x$ common

$\ln x = \log_e x$ natural

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$\frac{d}{dx} \ln x = \frac{1}{x}$

$\frac{d}{dx} \ln(\sin x) = \cos x \cdot \frac{1}{\sin x} = \cot x$

out in

$\frac{d}{dx} \ln(x^2+3x-1) = \frac{(2x+3)}{x^2+3x-1}$

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$\frac{d}{dx} \frac{x \ln x}{\tan x} = \frac{\tan x\left(x \cdot \frac{1}{x} + \ln x\right) - x \ln x \sec^2 x}{\tan^2 x}$

change of base $\log_a x = \frac{\log_b x}{\log_b a}$

$\log x = \frac{\ln x}{\ln 10}$

$\frac{d}{dx} \log x = \frac{1}{x \ln 10}$

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$\frac{d}{dx} \log_a u = \frac{du}{dx} \cdot \frac{1}{u \ln a}$

$\frac{d}{dx} \log_5(x^2) = 2x \cdot \frac{1}{x^2 \ln 5} = \frac{2}{x \ln 5}$

$\frac{d}{dx} 2 \log_5 x = 2 \cdot \frac{1}{x \ln 5}$

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logarithmic differentiation

1. take ln of both sides
2. use properties of ln to simplify
3. do implicit diff. to find $\frac{dy}{dx}$

$y = x^x$ find $\frac{dy}{dx}$

1. $\ln y = \ln x^x$
2. $\ln y = x \cdot \ln x$
3. $\frac{1}{y} \frac{dy}{dx} = x \cdot \frac{1}{x} + \ln x \cdot 1$

$\frac{dy}{dx} = (1 + \ln x) y$

$\frac{dy}{dx} = (1 + \ln x) x^x$

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